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# FARES ANALYSIS DEMONSTRATION STUDY

PROPOSAL  
BY  
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STAGE I PRELIMINARY RESEARCHTASK A: Literature Review

The first phase of the study will be to carry out a thorough review of published literature, research reports, conference proceedings and other sources with the aim of establishing the range of typical values of fares elasticity that have been derived for urban mass transit systems both in North America and in Europe. London Transport have assembled a library of existing research work and this will be used as one basis for the review of the available information sources.

London Transport have accumulated considerable knowledge and experience in estimating fares elasticities over the last ten years during which it has experienced both dramatic changes in fares levels and also the type of fares and ticketing system employed. The review will include a survey of the formulation of urban fare and service elasticities for public transit and their application under different fares structures. In particular, the application of elasticities under different fare systems covering flat fares, user cards, zonal and mileage related fare systems will be explored. Detailed research studies by LT on different pricing systems show the revenue raising capabilities of each system.

The literature search will form the basis of a review of the formulation of fares and service elasticities and the methodology used in their identification. It is important to distinguish between different definitions of elasticity and to establish which are appropriate for the proposed study. The review will include an assessment of relevant past analysis carried out by the CTA.

TASK B: Fares Policy Objectives and Constraints

It is important to establish with CTA exactly what their corporate aim is in regard to fares policy and to determine the constraints which may limit the range of possible fare and other strategies which can be adopted to achieve that aim.





A number of alternative objectives may be applied when meeting financial and service targets. For instance, one aim might be to maximise patronage (ie measured in passenger-miles) within an overall financial constraint.

Alternatively, a simple net revenue maximization/net loss minimization objective may apply. Various policy constraints may be relevant:

- . Maximum load factors on vehicles
- . Minimum levels of service eg at weekends, evenings
- . Maximum permissible fares or fare increases
- . Acceptable ticket types, fare collection method
- . Acceptable levels of fare evasion

Discussions with the CTA will be held to establish all the relevant factors to be taken into account during the study. These discussions will also cover other constraints on present and future fares policy of a political/institutional nature:

- . The need to give preferential fares to certain types of passenger
- . Acceptability to staff of changes in fare collection method
- . Regulatory restrictions

All relevant financial trends for CTA operation will be identified so that a clear understanding of the key features of the urban transit market is obtained together with the impact of likely future financial and other constraints.

#### TASK C: Fare System Overview and Review of Existing Data

The main aim of work for this task will be to establish in detail what data are available, either from within the CTA or from external sources relevant to the study.



A subsidiary aim will be to ensure a thorough understanding of the existing CTA fares system and the nature of the passenger demand it is designed to accommodate.

- . Existing structure of route network in relation to major traffic objectives and local geographical features
- . The amount of transfers by mode/market
- . Existing travel patterns by area and time period
- . Trip length distribution by time period and main travel market
- . Fares structure history
- . Ticketing arrangements by mode including the extent of pre-payment sales
- . Patronage and Revenue time series by mode/market
- . The extent of routine data captured for accounting and service planning
- . The scope of additional data collection eg from special surveys
- . Marketing and fares publicity practices
- . Measures to control fares evasion

This review will be primarily concerned with the fixed-route public transport network covering both bus and rail services. Once data sources have been identified the extent of further data collection required can be established.

It is understood that the CTA has comprehensive Origin/Destination travel data for 1979 which is complemented by a 1983 trip component survey providing data on transfer journeys. Additional processing of these data sources will probably be required to provide trip length information etc., and this cost will be borne by the CTA.

#### TASK D: Initial Report and Preliminary Policy Assessment

The results of the review carried out in Stage I of the study will be used to describe the basis for further work, to outline the scope for change and to carry out a preliminary policy assessment of the way in which new fares systems could affect CTA patronage and revenue levels. This will provide only a preliminary indication of possibilities for CTA consideration but will aim to identify the likely directions of overall financial strategy.



The report will also summarise findings on urban elasticity values and formulation and their application in North America and elsewhere within the urban transit planning and management process.

Since the scope of achievable work in Stages II' and III of the study will, to a great extent, depend on the quality of existing data investigated under Task C, it will be necessary at this stage to review the content and timescale of the remainder of the study making any necessary arrangements for additional data collection/updating.



Introduction

A key feature in the development of a revenue optimisation system for Chicago Transit Authority is a sound and comprehensive understanding of the basic response of its riders to fare systems and structures. To achieve this the second stage of the study will consist of a market research survey and analysis designed to estimate the responsiveness (i.e elasticities) of CTA travellers to fare changes. This exercise will be carried out using elements of the "SIGNALS" transit system planning package which has been specifically designed to estimate such responses for mass transit users and time series analysis. The 'SIGNALS' package is designed to estimate long run demand elasticities from cross-sectional data using an attitudinal model.

The conventional approach to transport demand forecasting suffers from two main drawbacks:

- \* Historical data as incorporated in direct demand models reflect the short run impacts of fare systems. As a result elasticities based on historical data will tend to underestimate the effect of fundamental fare and financial structure changes.
- \* Conventional transport planning models do not perform adequately due to the extensiveness of data requirements and their inability to provide 'arc' elasticities. The cost of data collection is so considerable that the effective estimation of even 'point' demand elasticities for mass transit is very expensive and frequently indeterminate.

The SIGNALS approach, in contrast, while involving a data collection exercise similar to that employed for conventional modal choice studies, carries out an analysis of this information which is largely concerned with the definition of existing consumer markets and transport services. To provide knowledge on the likely consumer response to new fare systems limited market survey data





are required. These data will provide a base for the development of an attitudinal model that defines the consumer's response to specific transport fare, service and technology options.

The attitudinal modal used in the 'SIGNALS' package is an advanced market research tool, referred to as "Trade-Off analysis". The use of these techniques in transport is relatively new, major examples outside London Transport and British Railways are its use in the United States by the New York and Ohio State Departments of Transportation and in the United Kingdom by the Department of Transport.

There are a number of advantages in the 'Trade-Off' approach over conventional transportation analysis. Briefly these are the following:

- \* The techniques require data that are simple to collect and readily applicable to invehicle, terminal and household surveys.
- \* Consumer preferences and utility matrices for different modal characteristics are provided and thus enable the effect of a range of mass transit attributes (eg fares, frequency, convenience) to be tested.
- \* An overall picture of a desirable modal attribute is given and ways of promotion suggested.
- \* The usual difficulties of attitudinal research in which there are incentives for individuals to support the provision of facilities they have no intention of regularly using are avoided. The problem of reconciling "saying" and "doing" is overcome.
- \* A means for relating different responses to differences in trip making, location or socio-economic factors is provided.



- \* An input to financial studies is provided in that the response to different price and levels of service can be quantified in terms of demand. This creates a number of price/demand options from which preferred solutions may be derived, and revenues maximised.

The trade-off analysis procedure may be briefly described as follows:

Travel data are organised in a form enabling respondents to consider trade-offs either between desirable modal attributes such as comfort, fare, speed and accessibility, or under various forms of constraint such as income and budget constraints or price changes such as real increases in gasoline prices. The trade-offs will include fare and service options presented in such a way as to induce individuals to give a realistic response to the choice. This is the key to the successful use of trade-off analyses and requires considerable expertise and knowledge to obtain a realistic and balanced response from interviewees. Further explanation of trade off analysis is provided in Appendix 3.

The response of individuals to the different attributes and factors presented in the trade-off survey are then analysed to provide a ranking that describes the individual's behaviour within the trade-off. These rankings are applied to a simulation of the transport service provision at different fare levels to give a quantitative estimate of modal choice. In this way specific modal and cross elasticities are generated. It is these elasticities which provide the basis for demand and fare/revenue estimation.

#### TASK E: Survey Design

The objective of the Survey Design Stage will be to plan the trade-off analysis work for elasticity estimation. There will be three main activities for this task.

- Specify survey form content and design
- Determination of sample size and selection
- Mounting of pilot survey to test methodology in Chicago conditions



The results of this work will be the specification for trade-off analysis surveys, a detailed program for these surveys and preliminary requirements for analysis which will depend on the scope of the survey work. The main input to the survey form and content will be the information requirements determined during Stage I. This may extend beyond trade off surveys but no allowance for necessary extensions to survey work has been made in project costing.

#### TASK F: Survey

LTI consultants will organise the required survey work in co-operation with the CTA according to an agreed schedule and to quality standards to be determined. Trade-off surveys involve interviews although there may be scope for self-completion of some survey questions.

#### TASK G: Analysis

Results of the trade-off surveys will be analysed using existing survey analysis programs developed by LTI Consultants suitably modified to meet the requirements of the Chicago study. It is expected that most of this analysis will be carried out using Toronto-based data processing bureau facilities from a terminal located in Chicago. Alternatively, analysis may be undertaken in London within the same general timescale.

Output from the analysis phase will include:

- Detailed survey profile
- Input to Fare and other elasticities estimation
- Any refinements required to survey technique

#### TASK H: Fare System Review

A wide ranging review of all possible fare structures will be undertaken including:



- . distance based stage fares, coarsely or finely graduated with high or low taper;
- . zone fares, with consideration of zone size and configuration such as radial, grid or honeycomb;
- . flat fares, with or without transfer facility;
- . passes, including daily, weekly, monthly and annual versions, zone-based or system-wide and the general price relativity to single ride tickets; and
- . other tickets, such as pre-paid tickets for a fixed number of rides.

All options will be critically examined to determine their suitability in the context of CTA's requirements and constraints. This exercise will result in a short list of options to be evaluated in full.

The short list will be discussed with CTA who will have the opportunity to suggest any changes or additions felt to be relevant in the light of agreed revenue and other objectives identified during Stage I of the study. LTI Consultants will prepare a general estimate of implementation costs for each system jointly with CTA staff. Although care will be taken to identify all major cost headings and the general scale of costs it will not be possible to prepare detailed costings or implementation programs within the study timescale.

#### TASK I: 'Signals' Calibration

The derivation of modal cross elasticities and "own price" i.e. direct elasticities in the SIGNALS approach involve the calibration of an hierarchical generalised logit modal split model designed to encompass mode choices for each relevant market segment. The scope of this work must be subject to agreement with the CTA and to the findings from earlier study stages. It may be appropriate to address the following market segments:

- . Peak/off peak
- . Auto/public transit
- . Bus/Rail
- . Long/short distance trips





SIGNALS model development will involve a range of work, the extent of which will depend on the availability and form of travel and trip cost data for each mode and time period. It is proposed that calibration will be based on a trip sample from relatively few transportation zones selected to be representative of the urban travel market and the particular market segments of interest to the CTA. Using this approach it is intended that trip costs can be defined manually for a relatively small number of travel paths, obviating the need for network modelling. The sub-tasks proposed are:

- . Trip/path sampling and zonal aggregation
- . Identification of trip costs
- . Model calibration
- . Validation

Values of time input to this work will be derived from Trade Off analysis results.

#### TASK J: Elasticity estimation

Cross elasticities and 'own price' elasticities are derived from sensitivity testing using the modal split models and depend on the form of the model and the specification of generalised cost by mode.

Comparison will be undertaken with elasticity values established from other studies based on work in Stage I. The main sub-task will be to produce an elasticity data bank i.e. a bank of elasticity values by market segment for the short and long term for use in the development and operation of the policy model.



### STAGE III POLICY EVALUATION

#### TASK K: Development of Fares Policy Model

The elasticity data resulting from work during Stages I and II will be used in the construction of a fares policy model for the CTA. The model will be designed to project aggregate patronage and revenue on the basis of elasticities, transit network data, recent ridership and fares system data. It may be possible to incorporate simple operating cost forecasting models to enable net revenue (or net cost) projections to be made. The guiding principles in model development will be to provide an interactive tool for management capable of testing a wide range of fares options indicating how riders will respond to these options. Output for total CTA operation will be produced and it may be possible with the resources available to disaggregate by mode (bus and subway/el) and other market segments and to produce other disaggregate results such as benefits and disbenefits by ridership group.

The model will be used to indicate the likely impact of different fares structures and policies. To do this forecasts will be prepared for an agreed base case representing the continuation of existing CTA policy and for alternatives as agreed with CTA management.

#### TASK L: Results and Recommendations

The results of Tasks I - K will be summarised in the form of a "goals achievement matrix" designed to indicate the ability of fares policy alternatives to meet objectives for the CTA defined in Stage I. It is expected that this presentation will involve revenue and patronage projections, implementation costs, equity considerations and operating issues and could involve additional or different items as required.



#### TASK M: Downloading of Study Methodology for CTA use

During the course of the study the "SIGNALS" trade-off time series analysis package including the policy model will be set up at CTA offices on either a mainframe or micro computer capable of providing APL support eg IBM PC (XT). This will provide an on-going fare and revenue evaluation and optimisation system which can be used for monitoring and planning purposes. The system will incorporate:

- \* Mass transit ridership data
- \* Mass transit time, service characteristics and fares
- \* Fare systems and structures analysis
- \* Goal achievement matrix evaluation system

The system will be set up to allow additional sensitivity analysis for the preferred system and the testing of new fare systems and structures as necessary.

CTA staff will be trained in the use of the system and appropriate documentation will be provided.

#### TASK N: Final Report Preparation

A final report will be prepared building on the interim report provided at the end of Stage 1. This will contain the general specification for the recommended revenue maximizing CTA fares policy and will range over supply side factors if these prove relevant. The draft final report on the recommended policy will be presented to CTA management and Policy Board for approval.









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